

# WDM 200Gb/s Optical Transceiver Chip Modules with Quadrature Modulation and RF Transmission Capabilities based on WDM Electronic-Photonic Integration Platform, Phase I

Completed Technology Project (2018 - 2019)



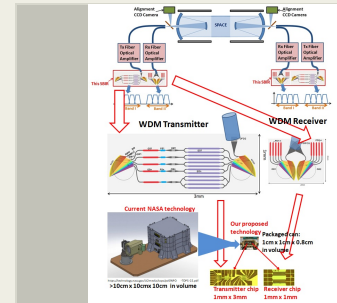
## Project Introduction

There have been significant interests from NASA in integrated optical transceiver chips for space optical communications, in particular space-qualifiable 1550nm laser transmitter and receiver with optoelectronic laser, modulator, and detector, that are capable of data rates from 1Gb/sec to 200Gb/sec. The power efficiency shall be better than 10W per Gb/sec and weight less than 100g per Gb/sec. In addition, hybrid RF-optical technologies are sought, and technology based on integrated photonic circuit solution is strongly desired. To address the abovementioned interests, our proposed works will focus on realizing 100-200Gb/sec high-data-rate Wavelength-Division-Multiplexed (WDM) photonic transceiver module that will be able to meet the above NASA requirements, based on a few key technologies we have developed including: (a) WDM Laser Transmitter with Concurrent Wavelength Locking Capability; (b) Ultra-Compact Wavelength Mux/DeMux; (c) Integrated Narrow Linewidth Laser; (d) Integrated 20-40Gb/sec Modulator with low voltage of  $\sim 1.5\text{V}$ ; (e) Ruggedized Wide-Temperature-Range Chip Packaging Module with large operating temperature range of  $-40^{\circ}\text{C}$  to  $100^{\circ}\text{C}$ .

## Anticipated Benefits

The main NASA application area is space qualifiable 1550 nm laser transmitter and receiver for data rates from 1 gigabits/s to >200 gigabits/s with power efficiencies better than 10W per gigabit/s and mass efficiencies better than 100 g per gigabit/s. Technologies for efficient waveform modulation, detection, and synchronization using Integrated photonic circuit solutions are strongly desired. Also of potential application interests are hybrid RF-optical transmissions.

**For Non NASA Commercial Applications**, the main market areas are computer Interconnect and Optical Network. Include Optical Transceiver Modules (OTMs) and "Active Optical Cables" (AOCs), used widely in data centers and networks. AOC market is \$500Mil/year and the OTM is \$4.4Bil/year currently. Other applications include coherent communications for network, and chip-to-chip optical interconnects with estimated market size of \$300Mil/year.



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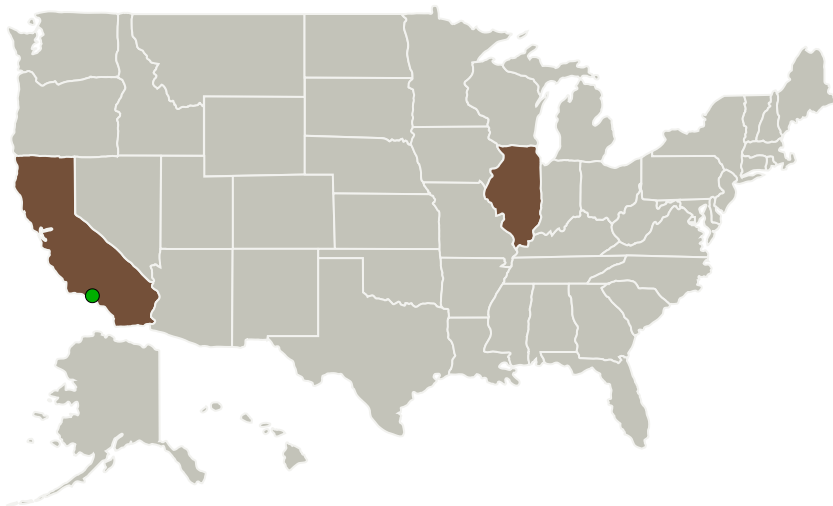
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Optonet, Inc.	Lead Organization	Industry Minority-Owned Business	Evanston, Illinois
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

### Primary U.S. Work Locations

California	Illinois
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## Project Transitions



**July 2018:** Project Start



**February 2019:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140145>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Optonet, Inc.

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

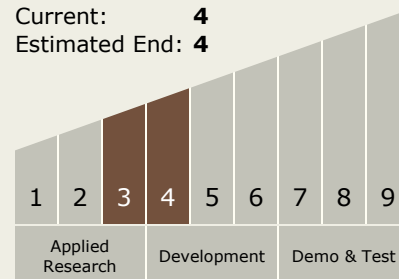
Carlos Torrez

### Principal Investigator:

Yingyan Huang

## Technology Maturity (TRL)

Start: 3  
Current: 4  
Estimated End: 4

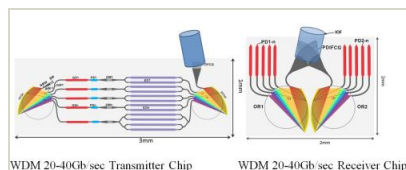
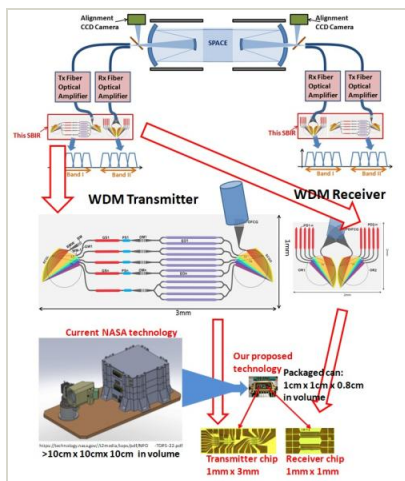


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## Images



### Final Summary Chart Image

WDM 200Gb/s Optical Transceiver Chip Modules with Quadrature Modulation and RF Transmission Capabilities based on WDM Electronic-Photonic Integration Platform, Phase I

(<https://techport.nasa.gov/image/128638>)

### Briefing Chart Image

WDM 200Gb/s Optical Transceiver Chip Modules with Quadrature Modulation and RF Transmission Capabilities based on WDM Electronic-Photonic Integration Platform, Phase I  
(<https://techport.nasa.gov/image/136515>)

## Technology Areas

### Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.1 Optical Communications
  - TX05.1.6 Optometrics

## Target Destination

Earth